Updates to the DoD Vapor Intrusion Handbook and the Latest in Vapor Intrusion News

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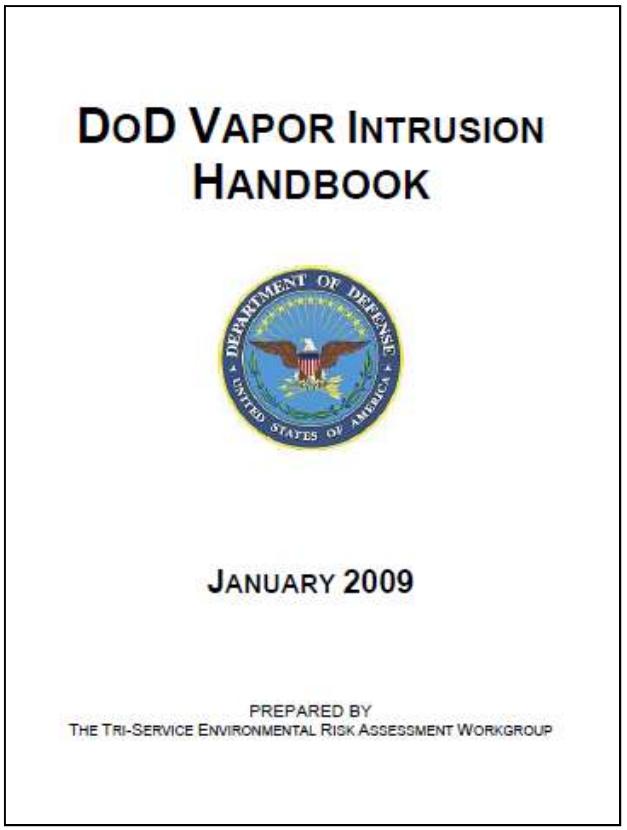
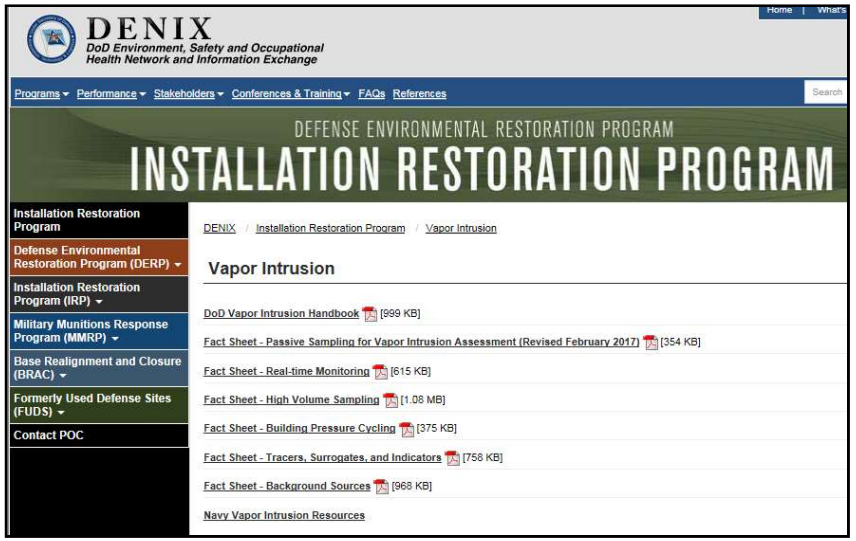
Objective

- Identify updates to DoD VI Handbook
- Describe VI technologies included in the updates
- Present what's new in VI
  - Challenges and solutions



Fact Sheets Update DoD VI Handbook

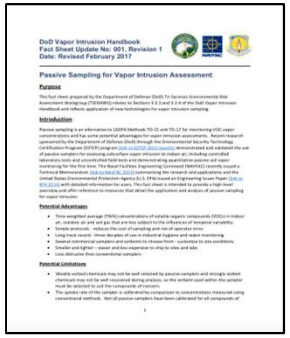
- Developed by TSERAWG
- Fact sheets posted on DoD DENIX website
  - http://www.denix.osd.mil/irp/vaporintrusion/
- Passive Sampling for Vapor Intrusion Assessment (001)
- Real-Time Monitoring for Vapor Intrusion Assessment (002)
- High Volume Soil Gas Sampling for Vapor Intrusion Assessment (003)
- Use of Building Pressure Cycling in Vapor Intrusion Assessment (004)



Fact Sheets Update DoD VI Handbook

- Use of Tracers, Surrogates, and Indicator Parameters in Vapor Intrusion Assessment (005)
- Determining the Influence of Background Sources on Indoor Air Concentrations in Vapor Intrusion Assessment (006)
- Screening and Prioritizing for Vapor Intrusion Assessments (in progress)
- Incorporating VI into the CERCLA Process (in progress)

Passive Sampling


DoD Vapor Intrusion Handbook
Fact Sheet Update No: 001, Revision 1
Date: Revised February 2017
Passive Sampling for Vapor Intrusion Assessment

Real-Time Monitors


DoD Vapor Intrusion Handbook
Fact Sheet Update No: 002
Date: February 2017
Real-Time Monitoring for Vapor Intrusion Assessment

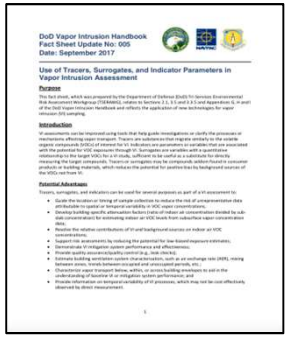
High-Volume


DoD Vapor Intrusion Handbook
Fact Sheet Update No: 003
Date: February 2017
High Volume Soil Gas Sampling for Vapor Intrusion Assessment

Pressure Cycling


DoD Vapor Intrusion Handbook
Fact Sheet Update No: 004
Date: August 2017
Use of Building Pressure Cycling in Vapor Intrusion Assessment

Tracers, Indicators, Surrogates


DoD Vapor Intrusion Handbook
Fact Sheet Update No: 005
Date: September 2017
Use of Tracers, Surrogates, and Indicator Parameters in Vapor Intrusion Assessment

Background Sources


DoD Vapor Intrusion Handbook
Fact Sheet Update No: 006
Date: September 2017
Determining the Influence of Background Sources on Indoor Air Concentrations in Vapor Intrusion Assessment

VI Challenges and Solutions

Background Sources	• Comparison to typical indoor / outdoor air data • Compound ratio analysis (indoor / subslab) • Pressure cycling • Real-time monitoring • Detailed building surveys & remove if feasible • Stable isotope "fingerprint" analysis
Temporal Variability	• Long-term passive sampling • Ultra-low-flow long duration canister sampling • Pressure cycling
Spatial Variability and Large Buildings	• High volume sampling • Real-time monitoring • Indicators/tracers/surrogates
Preferential Pathways	• Pressure cycling & real-time monitoring & indicators/tracers/surrogates

Passive Sampling

- ESTCP research validated passive sampling for vapor intrusion assessment

- Advantages
  - Time-weighted (> a week) average concentrations dampen variability
  - Simple protocols with industrial hygiene / radon monitoring track record
  - Customize samplers and sorbents to site conditions
  - Smaller, lighter, less expensive
  - Easy to deploy

- Limitations
  - Sorbent/chemical compatibility
  - Need to know / manage uptake rate; uptake rate of sampler should be calibrated for chemicals of concern (COCs)
  - Not suited for full suite analysis (multiple sorbents/sampler types)

- Time weighted concentration (C) is calculated from the mass (M) of each VOC (determined by laboratory analysis of the sorbent) divided by the product of the sample duration (t) and the uptake rate (UR):

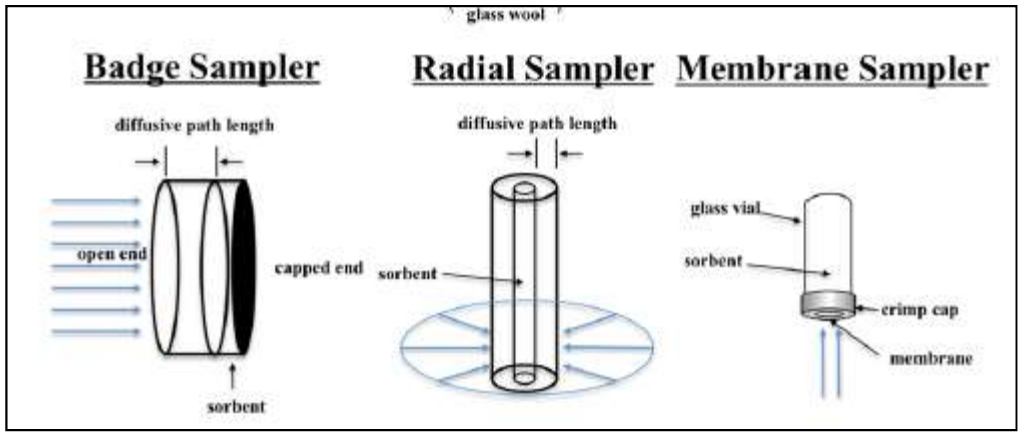
$$C = \frac{M}{UR\ t}$$

Passive Sampling

- Design Considerations
  - Sampler configuration & calibrated uptake rates for COCs
  - Sorbent selection for COCs
  - Sample duration consistent with DQOs & reporting limits

3M OVM 3500

- Applications
  - Indoor/outdoor
    - Better estimate of chronic exposure (1-2 week duration samples)
    - Short-term / acute exposures need sampler with high uptake rate
  - Soil Vapor
    - Uptake rate less than diffusion through soil (starvation effect)



Real-Time Monitoring

- Sample results in seconds to minutes with portable instrumentation
  - GC/MS, GC/ECD, GC/PID
  - PID, FID, landfill gas meter, tracer gas meter

DoD Vapor Intrusion Handbook
Fact Sheet Update No: 002
Date: February 2017

Real-Time Monitoring for Vapor Intrusion Assessment

Purpose

This fact sheet prepared by the Department of Defense (DoD) Tri-Services Environmental Risk Assessment Workgroup (TSERAWG) relates to Sections 2, 3, and Appendix D of the DoD Vapor Intrusion Handbook, and reflects application of new technologies for vapor intrusion sampling.

- Advantages
  - Supports real time decisions
  - Understand cause-and-effect relationships for better CSM
  - Rapid data interpretations can save time and money
  - Line of evidence to validate data integrity

- Limitations
  - Cost and sensitivity of real-time monitoring instruments
  - Moment in time sample result
  - Finite location sample result

Real-Time Monitoring

- Applications
  - Identifying indoor sources
  - Identifying vapor entry points
  - Screen indoor air spaces
  - Indicator of biodegradation
    - Landfill gas meter (O_2, CO_2, CH_4)
  - Understand vapor migration and air flow when used with:
    - Building pressure cycling
    - HVAC adjustments
    - Differential pressure monitoring
    - Tracers (radon, SF_6)

High Volume Soil Gas Sampling

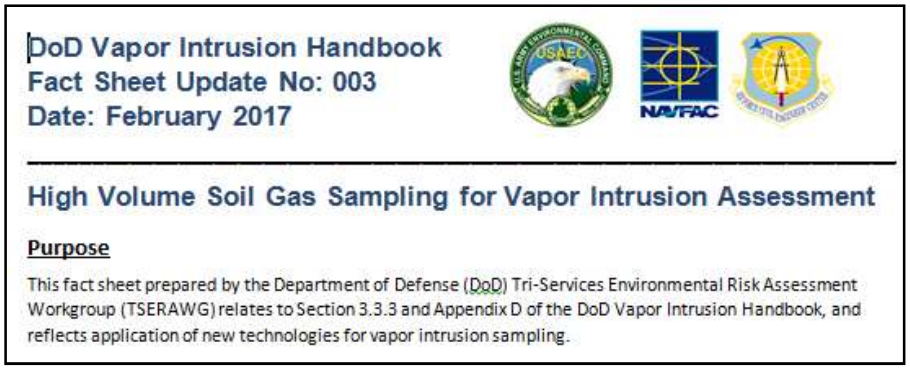
- Remove large volume soil gas and monitor response
  - Vacuum extract 10-100 liters 30 to 90 minutes
  - Assess soil gas concentration, distribution

- Design
  - Fan / blower connected to subslab extraction port
  - Monitoring ports distant from extraction point (~ groundwater pump test)
  - Pitot tube or thermal anemometer for flow velocity
  - Real-time monitoring of O_2, CO_2 and CH_4, and VOCs

(Courtesy of Geosyntec Consultants, Inc.)

High Volume Soil Gas Sampling

- Advantages
  - Fewer locations to assess large areas saving time and money
  - Less chance of missing subslab hotspot area
  - Assess soil gas in areas not accessible for subslab port
  - Aid in identifying atypical preferential pathway
  - Data for optimal subslab venting system design



DoD Vapor Intrusion Handbook
Fact Sheet Update No: 003
Date: February 2017

High Volume Soil Gas Sampling for Vapor Intrusion Assessment

Purpose

This fact sheet prepared by the Department of Defense (DoD) Tri-Services Environmental Risk Assessment Workgroup (TSERAWG) relates to Section 3.3.3 and Appendix D of the DoD Vapor Intrusion Handbook, and reflects application of new technologies for vapor intrusion sampling.

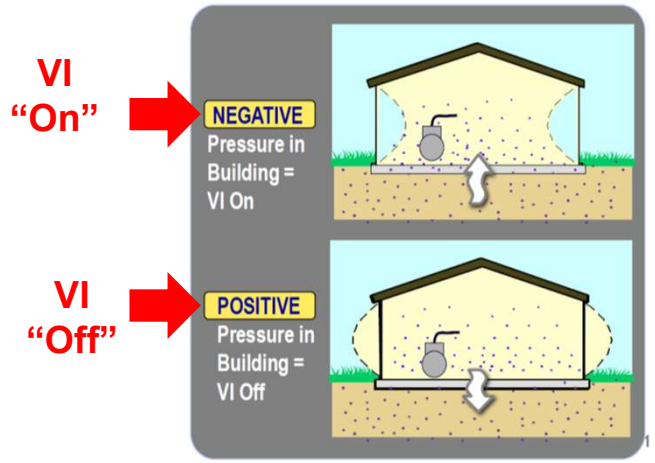
- Limitations
  - Clay-rich or wet soils can yield low flow rates
  - Manage discharge and/or treatment of extracted volume of soil gas
  - Greater equipment requirements than conventional subslab sampling
  - Disruption to occupants greater than conventional subslab sampling

Building Pressure Cycling

- Measure indoor air under manipulated building pressure and ventilation to turn VI on/off

- Advantages
  - Identify near worst-case VI to manage variability
  - Identify indoor source contributions
  - Identify atypical preferential pathway with real-time monitoring
  - Cost effective to minimize sample events and identify background

- Limitations
  - Large spaces can be difficult to depressurize or pressurize



Beckley, 2014 AEHS

DoD Vapor Intrusion Handbook
Fact Sheet Update No: 004
Date: August 2017

Use of Building Pressure Cycling in Vapor Intrusion Assessment

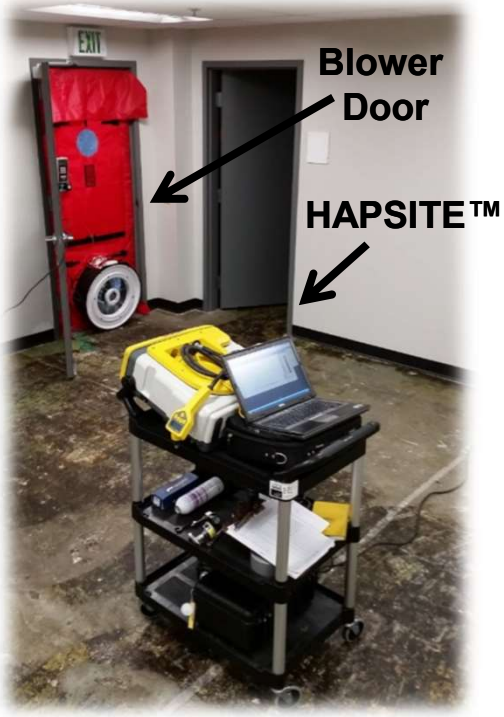
Purpose

This fact sheet relates to Sections 2.7, 2.8, 3.34, 3.5 and Appendix G of the DoD Vapor Intrusion Handbook. These sections describe methods for indoor air sampling and determining the influence of background sources. Building pressure cycling (BPC) offers an alternative approach to the methods described in the Handbook.

Building Pressure Cycling

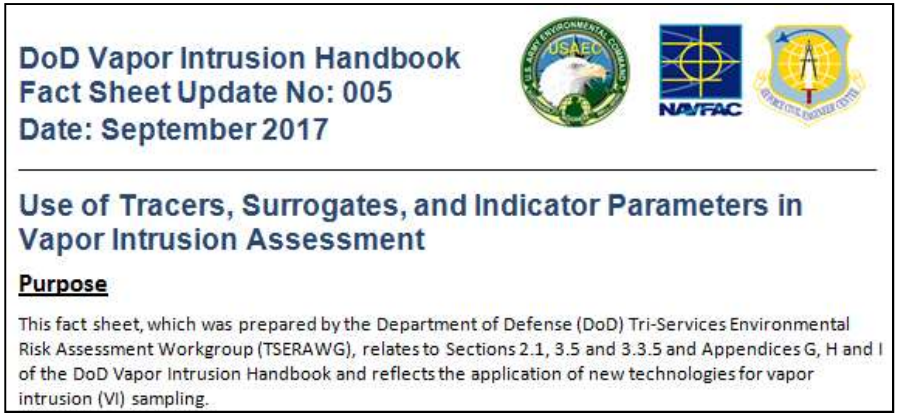
- Design
  - Conduct baseline differential pressure across slab
    - Generally ranges between ± 5-10 pascals (some can be higher)
  - Fan, blower door or HVAC adjustment to pressurize or depressurize space
  - Measure differential pressure and VOCs across slab under varying pressures
  - Screen vapor entry points under negative pressures

- Interpretations
  - Detecting VOCs under positive pressure (VI off) suggest indoor source
  - Increasing VOCs under negative pressures (VI on) can estimate near worst case VI



Tracers, Surrogates and Indicators

- Tracers mimic VOC VI migration
  - SF6, He, radon
  - Release tracers in subsurface or preferential pathways (sewer pipes) and monitor indoor air
- Surrogates substitute for VI VOC
  - Radon indoor air subslab ratio to estimate slab attenuation
  - VOCs (e.g. 1,1DCE, cis12DCE) not commonly found in background
- Indicators of potential VI exposures
  - Building pressure / temperature
  - Subslab PID / FID screen



DoD Vapor Intrusion Handbook
Fact Sheet Update No: 005
Date: September 2017

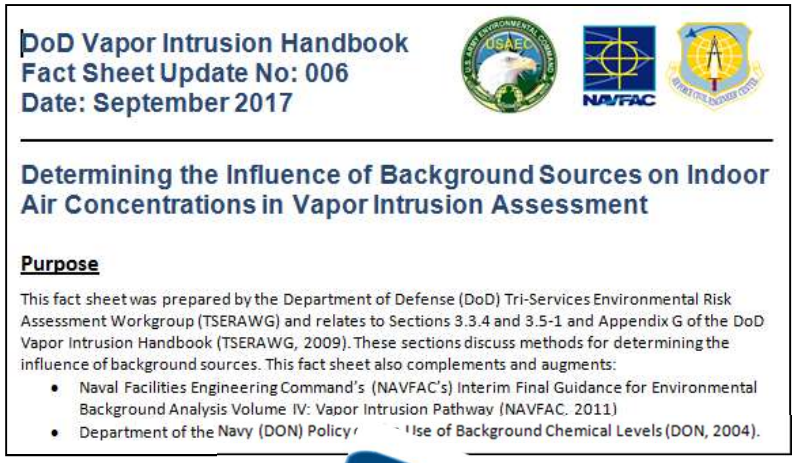
Use of Tracers, Surrogates, and Indicator Parameters in Vapor Intrusion Assessment

Purpose

This fact sheet, which was prepared by the Department of Defense (DoD) Tri-Services Environmental Risk Assessment Workgroup (TSERAWG), relates to Sections 2.1, 3.5 and 3.3.5 and Appendices G, H and I of the DoD Vapor Intrusion Handbook and reflects the application of new technologies for vapor intrusion (VI) sampling.

Background Sources

- Continues to confound VI assessments
- Investigation strategies
  - Limit indoor air sampling for subsurface vapor source VOCs
  - Building survey of indoor sources
    - Remove <u>if feasible/reasonable</u>
  - Outdoor air sampling
  - Subslab/indoor air constituent ratio analysis
  - Pressure cycling
  - Real-time monitoring
  - Stable isotope analysis



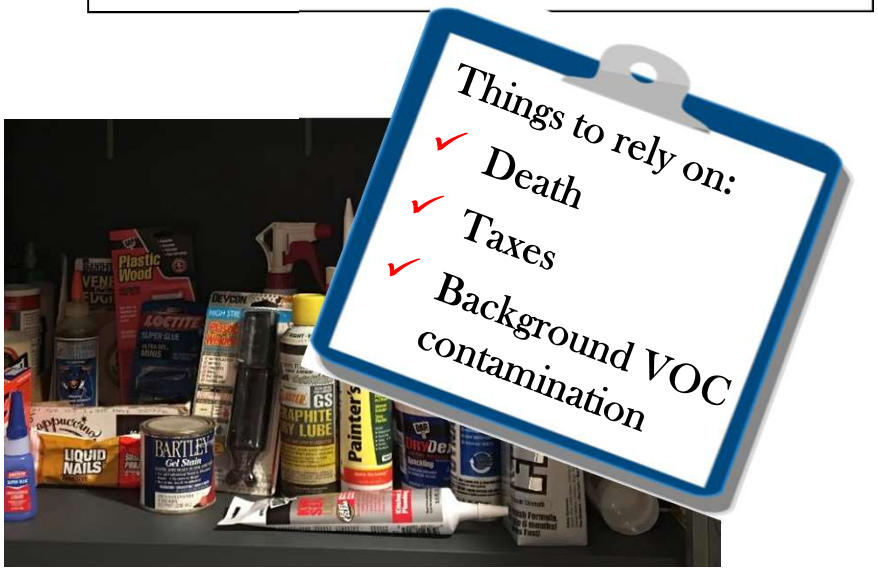
DoD Vapor Intrusion Handbook
Fact Sheet Update No: 006
Date: September 2017

Determining the Influence of Background Sources on Indoor Air Concentrations in Vapor Intrusion Assessment

Purpose

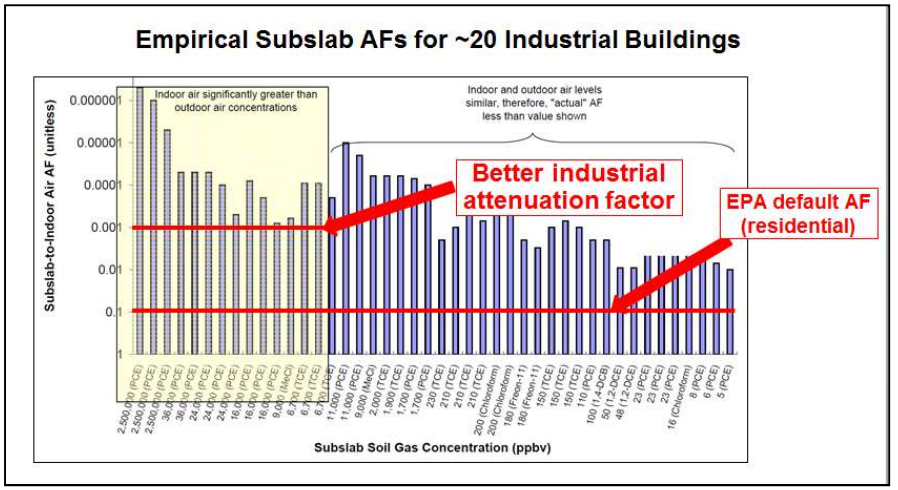
This fact sheet was prepared by the Department of Defense (DoD) Tri-Services Environmental Risk Assessment Workgroup (TSERAWG) and relates to Sections 3.3.4 and 3.5-1 and Appendix G of the DoD Vapor Intrusion Handbook (TSERAWG, 2009). These sections discuss methods for determining the influence of background sources. This fact sheet also complements and augments:

- Naval Facilities Engineering Command's (NAVFAC's) Interim Final Guidance for Environmental Background Analysis Volume IV: Vapor Intrusion Pathway (NAVFAC, 2011)
- Department of the Navy (DON) Policy [illegible] Use of Background Chemical Levels (DON, 2004).



What's New in the VI Queue?

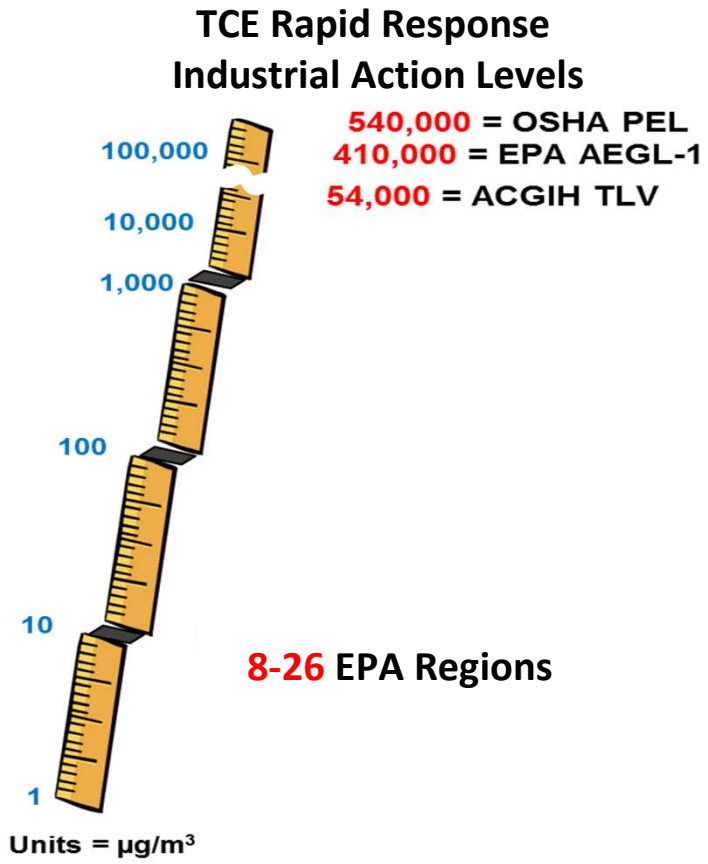
- Fact sheets planned
  - Selection of Effective VI Investigation Technologies
  - Design and Monitoring Considerations for Vapor Intrusion Mitigation
- Expanding the VI database of industrial buildings
  - Adding VI data sets for 30 buildings
  - "Re-stir" the statistical pot
  - Validate the quantitative decision framework (RITS 2016)
  - RPM QDF User Guide



What's New in the VI Queue?

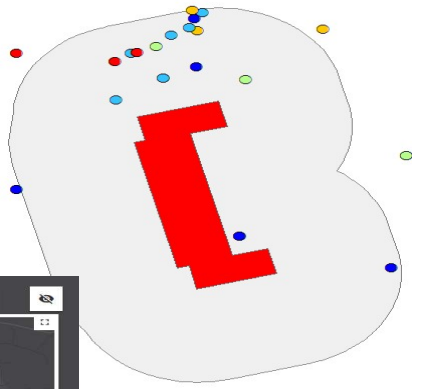
- Developing a VI NEDD for NIRIS
  - Capture non-analytical VI data
- EDQW developing at VI QAPP Worksheet Template
- NESDI study of temporal variability
- Weight of evidence paper for managing TCE in non-residential buildings

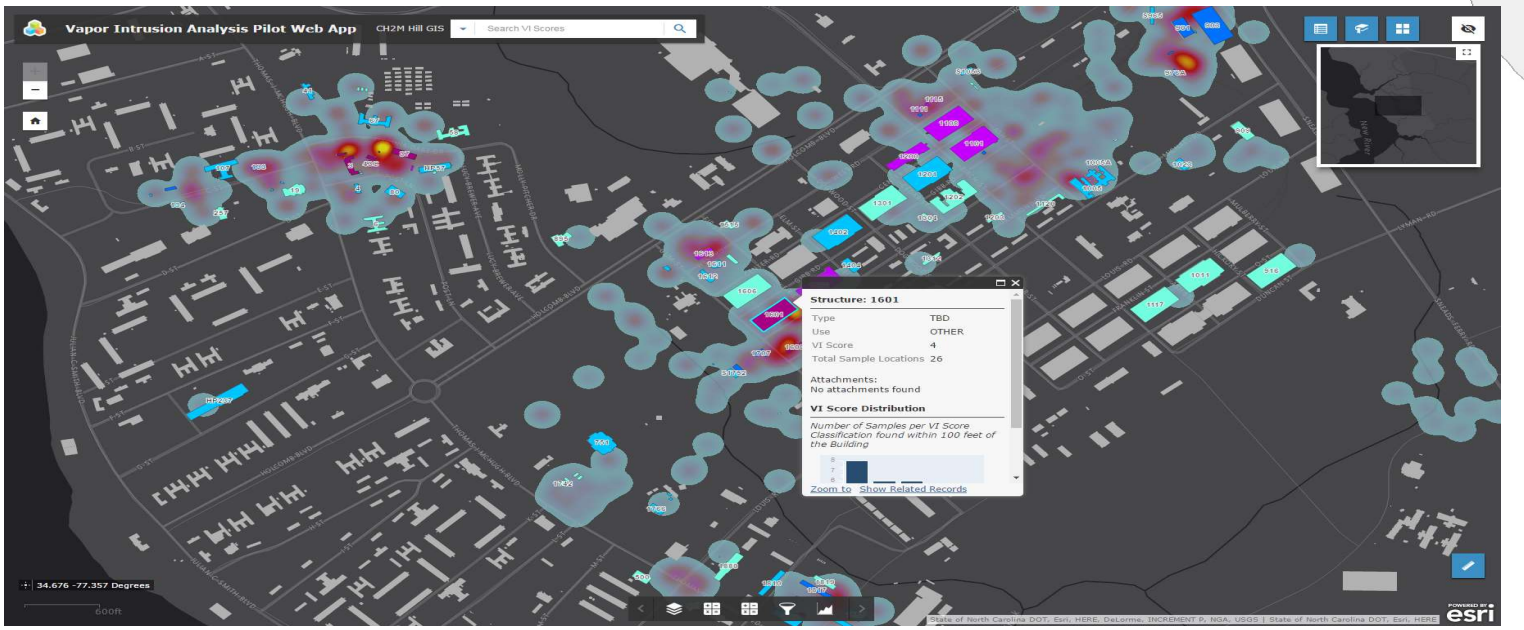
Low action level + single exposure + rapid response = CHAOS



What's New in the VI Queue?

- VI NIRIS/GIS screening
  - Use NIRIS to screen for potential VI buildings of concern from groundwater data (soil gas up next)
  - 7 compounds (usual suspects)
  - Spatial Analysis to score buildings VI potential





Knowledge Check

This sampling technique helps manage spatial variability under very large buildings?

- Passive samples
- Pressure cycling
- High volume sampling
- Subslab canister samples

This sampling technique helps manage temporal variability?

- Passive samples
- Indoor canister samples
- Real-time monitoring
- Isotopic Analysis

Knowledge Check

CSM: Very large 500,000 sqft industrial bldg., low concentration TCE plume at water table, high TCE bottom of 40 ft aquifer. Potential for vadose zone source in NE quadrant of bldg.

Which of the following would you include in the VI investigation work plan?

- Indoor canister samples
- Outdoor canister samples
- Subslab canister samples
- Real-time monitoring
- Remove indoor sources
- Pressure cycling
- Isotopic Analysis
- Passive samples
- Radon samples
- Constituent ratio analysis

Summary

- DoD VI Handbook updated via topic-specific fact sheets
  - Passive Sampling
  - Real-Time
  - High Volume Soil Gas Sampling
  - Building Pressure Cycling
  - Tracers, Surrogates, and Indicator Parameters
  - Background Sources
- Ongoing VI efforts
  - VI NEDD
  - VI QAPP Template
  - Leadership guidance for TCE in non-residential buildings
- New tools and resources out there- **USE THEM**

Contacts and Questions

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Questions ?